What is claimed is:

1. A process for pulling a single crystal silicon ingot in accordance with the Czochralski method, wherein a seed crystal is brought into contact with a silicon melt contained within a crucible, which is coaxial with the seed, and then is withdrawn therefrom to form a neck adjacent the seed crystal, a seed-cone adjacent the neck, and a constant diameter portion adjacent the seed-cone, the constant diameter portion having (i) a nominal diameter of at least 150 mm, (ii) a length, L, as measured along the axis of the ingot from a transition from the seed-cone to the constant diameter portion, (iii) a first series of positions, $P_{(1\rightarrow n)}$, located a distance, $D_{(1\rightarrow n)}$, respectively, from the transition along the axis determined as a fraction of L, and (iv) a second series of positions, $PP^{(1\rightarrow n)}$, located a distance, $DD^{(1\rightarrow n)}$, respectively, from the transition along the axis determined as a fraction of L, wherein positions and their respective distances in the second series may be the same or different from those in the first, the process comprising:

rotating the seed crystal and the crucible in opposite directions;

decreasing a mean crucible rotation rate (CR) as a function of increasing axial length of the constant diameter portion of the ingot wherein the mean crucible rotation rate at a position, P_1, is greater than the mean crucible rotation rate at a position, P_2, wherein $D_2 \geq (D_1 + 0.1L)$; and,

controlling an average axial oxygen content in the constant diameter portion to be substantially constant by crucible rotation rate modulation (CRM).

2. The process of claim 1 wherein D_2 is about 0.8L.

3. The process of claim 2 wherein D_1 is less than about 0.6L.

4. The process of claim 2 wherein D_1 is less than about 0.4L.

5. The process of claim 1 wherein D_2 is about 0.6L.

6. The process of claim 5 wherein D_1 is less than about 0.4L.

7. The process of claim 5 wherein D_1 is less than about 0.2L.

8. The process of claim 1 wherein CR decreases substantially linearly between positions P_1 and P_2.

9. The process of claim 1 wherein D_1 is about 0.1L, CR being substantially constant from the transition to position P_1.

10. The process of claim 2 wherein CR is substantially constant from P_2 to about the end of the constant diameter portion of the ingot.

11. The process of claim 1 wherein CRM is increased as a function of increasing axial length of the constant diameter portion of the ingot.

12. The process of claim 11 wherein an amplitude of CRM at a position, PP^1, is less than the amplitude at a position, PP^2, wherein $DD^2 \geq DD^1$.

13. The process of claim 12 wherein $DD^2 \geq (DD^1 + 0.1L)$.

14. The process of claim 12 wherein DD^2 is about 0.8L.

15. The process of claim 14 wherein DD^1 is less than about 0.6L.

16. The process of claim 14 wherein DD^1 is less than about 0.4L.

17. The process of claim 14 wherein DD^1 is less than about 0.2L.

18. The process of claim 12 wherein DD^2 is about 0.6L.

19. The process of claim 18 wherein DD^1 is less than about 0.4L.

20. The process of claim 18 wherein DD^1 is less than about 0.2L.

21. The process of claim 12 wherein DD^2 is about 0.4L.

22. The process of claim 21 wherein DD^1 is less than about 0.2L.

23. The process of claim 12 wherein DD^1 is about 0.1L, the amplitude of CRM from about the transition to position PP^1 being about zero.

24. The process of claim 23 wherein DD^2 is about 0.4L, the amplitude between positions PP^1 and PP^2 increasing substantially linearly.

25. The process of claim 23 wherein DD^2 is about 0.6L, the amplitude between positions PP^1 and PP^2 increasing substantially linearly.

26. The process of claim 23 wherein DD^2 is about 0.8L, the amplitude between positions PP^1 and PP^2 increasing substantially linearly.

27. The process of claim 12 wherein DD^1 is between about 0.1L and about 0.4L and DD^2 is between about 0.6L and about 0.9L, the amplitude of CRM increasing from a value between about 0.1 to less than about 2 rpm, at position PP^1 to a value between greater than about 2 to about 4 rpm, at position PP^2.

28. The process of claim 1 wherein CRM is increased as a function of axial length of the constant diameter portion of the ingot, said increase having an amplitude which is a function of a sine wave.

29. The process of claim 1 wherein CRM has an amplitude which ranges from about ±5% to about ±40% of CR.

30. The process of claim 1 wherein CRM has an amplitude which ranges from about ±15% to about ±25% of CR.

31. The process of claim 1 wherein CRM has an amplitude which ranges from about 2 to about 8 rpm above and below CR.

32. The process of claim 1 wherein CRM has a period ranging from about 30 seconds to about 90 seconds.

33. The process of claim 1 wherein CR ranges from about 5 to about 15 rpm during growth of the constant diameter portion.

34. The process of claim 33 wherein D_1 is between about 0.1L to 0.4L and D_2 is between about 0.6L to 0.9L, CR decreasing between positions P_1 and P_2 from a value between about 10 rpm to about 12 rpm to a value between about 6 rpm to about 8 rpm.

35. The process of claim 1 wherein the constant diameter portion has an average axial oxygen concentration of at least about 12 PPMA.

36. The process of claim 1 wherein the constant diameter portion has an average axial oxygen concentration which varies by less than about 4% as a function of length.

37. The process of claim 1 wherein the constant diameter portion has an average axial oxygen concentration which varies by less than about 2% as a function of length.

38. The process of claim 1 wherein the constant diameter portion of the ingot is grown in the absence of an applied magnetic field.

39. The process of claim 1 wherein the constant diameter portion of the ingot has an axial length of at least about 750 mm.

40. The process of claim 1 wherein the constant diameter portion of the ingot has a nominal diameter of at least about 200 mm.

41. The process of claim 1 wherein the constant diameter portion of the ingot has a nominal diameter of at least about 300 mm.

42. A single crystal silicon ingot prepared by the process of claim 1.

43. A process for pulling a single crystal silicon ingot in accordance with the Czochralski method, wherein a seed crystal is brought into contact with a silicon melt contained within a crucible, which is coaxial with the seed, and then is withdrawn therefrom to form a neck adjacent the seed crystal, a seed-cone adjacent the neck, and a constant diameter portion adjacent the seed-cone, the constant diameter portion having a nominal radius extending from the axis to a lateral surface thereof of at least 75 mm, the process comprising:

rotating the seed crystal and the crucible in opposite directions;

rotating a crucible at a mean crucible rotation rate (CR) during growth of the constant diameter portion which is sufficient to obtain a melt-solid interface having a height near the axis, Z_a, of at least about 5 mm, as measured from the melt surface, and a height $Z_{R/2}$, where $Z_{R/2}$ is the height of the interface above the melt surface at about a midpoint of the radius, which is at least about 120% of Z_a; and,

controlling an average axial oxygen content in the constant diameter portion to be substantially constant by crucible rotation modulation (CRM).

44. The process of claim 43 wherein said interface is present after about 20% of the constant diameter portion has been formed.

45. The process of claim 43 wherein said interface is present after about 40% of the constant diameter portion has been formed.

46. The process of claim 43 wherein said interface is present after about 60% of the constant diameter portion has been formed.

47. The process of claim 43 wherein said interface is present after about 80% of the constant diameter portion has been formed.

48. The process of claim 43 wherein said constant diameter portion has an axial length of at least about 750 mm.

49. The process of claim 43 wherein Z_a is at least about 10 mm.

50. The process of claim 43 wherein Z_a is at least about 12 mm.

51. The process of claim 43 wherein $Z_{R/2}$ at least about 125% of Z_a.

52. The process of claim 43 wherein $Z_{R/2}$ at least about 135% of Z_a.

53. The process of claim 43 wherein CRM is initiated after about 5% of the constant diameter portion has been grown.

54. The process of claim 43 wherein CRM is initiated after about 10% of the constant diameter portion has been grown.

55. The process of claim 43 wherein CRM is modulated as a function of a sine wave.

56. The process of claim 43 wherein the constant diameter portion of the ingot has a nominal radius of at least about 100 mm.

57. The process of claim 43 wherein the constant diameter portion of the ingot has a nominal radius of at least about 150 mm.

58. A single crystal silicon ingot prepared by the process of claim 43.

59. A process for pulling a single crystal silicon ingot in accordance with the Czochralski method, wherein a seed crystal is brought into contact with a silicon melt contained within a crucible, which is coaxial with the seed, and then is withdrawn therefrom to form a neck adjacent the seed crystal, a seed-cone adjacent the neck, and a constant diameter portion adjacent the seed-cone, the

constant diameter portion having a nominal diameter of at least 150 mm, the process comprising:

rotating the seed crystal and the crucible in opposite directions;

controlling a ratio v/G_0, wherein v is a growth velocity and G_0 is an average axial temperature gradient over a temperature range from solidification to no less than about 1300°C for at least a segment of the constant diameter portion of the ingot, control of said ratio comprising decreasing a mean crucible rotation rate (CR) as said segment is grown;

controlling an average axial oxygen content in the segment to be substantially constant by crucible rotation modulation (CRM); and,

controlling a cooling rate of said segment from the solidification temperature to about 1,050°C or less, wherein said segment comprises an axially symmetric region which is substantially free of (i) agglomerated vacancy defects, or (ii) A-type agglomerated interstitial defects.

60. The process of claim 59 wherein, upon cooling of said segment from the solidification temperature, interstitials are the predominant intrinsic point defect in said axially symmetric region.

61. The process of claim 60 wherein said region is substantially free of B-type agglomerated interstitial defects.

62. The process of claim 61 wherein said axially symmetric region extends radially inward from the lateral edge of the ingot and has a width, as measured from the lateral edge radially toward the central axis, which is about 100% of the radius of the ingot.

63. The process of claim 62 wherein said region has a length, as measured along the central axis, of at least about 60% of the axial length of the constant diameter portion of the ingot.

64. The process of claim 62 wherein said region has a length, as measured along the central axis, of at least about 90% of the axial length of the constant diameter portion of the ingot.

65. The process of claim 59 wherein, upon cooling of said segment from the solidification temperature, vacancies are the predominant intrinsic point defect in said axially symmetric region.

66. The process of claim 65 wherein said axially symmetric region extends radially outward from the central axis and has a width, as measured from the central axis radially toward the lateral edge, which is about 100% of the radius of the ingot.

67. The process of claim 66 wherein said region has a length, as measured along the central axis, of at least about 60% of the length of the constant diameter portion of the ingot.

68. The process of claim 66 wherein said region has a length, as measured along the central axis, of at least about 90% of the length of the constant diameter portion of the ingot.

69. The process of claim 59 further comprising cooling said segment to a temperature less than about 800°C and, as part of said cooling step, quench cooling at least a portion of said the segment through the temperature of nucleation for the agglomeration of self-interstitial defects.

70. The process of claim 59 wherein the segment of the constant diameter portion has (i) a length, L, as measured along the axis of the ingot from a transition from the seed-cone to the constant diameter portion, (ii) a first series of positions, $P_{(1\rightarrow n)}$, located a distance, $D_{(1\rightarrow n)}$, respectively, from the transition along the axis determined as a fraction of L, and (iii) a second series of positions, $PP^{(1\rightarrow n)}$, located a distance, $DD^{(1\rightarrow n)}$, respectively, from the transition along the axis determined as a fraction of L, wherein positions and their respective distances in the second series may be the same or different from those in the first, and further wherein the mean crucible rotation rate (CR) is decreased as a function of increasing axial length of the segment, wherein the mean crucible rotation rate at a position, P_1, is greater than the mean crucible rotation rate at a position, P_2, wherein $D_2 \geq (D_1 + 0.1L)$.

71. The process of claim 70 wherein CRM is increased as a function of increasing axial length of the segment of constant diameter portion of the ingot.

72. The process of claim 71 wherein an amplitude of CRM at a position, PP^1, is less than the amplitude at a position, PP^2, wherein $DD^2 \geq DD^1$.

73. The process of claim 72 wherein $DD^2 \geq (DD^1 + 0.1L)$.

74. The process of claim 59 wherein constant diameter portion has a nominal diameter of at least about 200 mm.

75. The process of claim 59 wherein constant diameter portion has a nominal diameter of at least about 300 mm.